CHAPTER 5

LARGE SOURCES AND PROCESS UNITS -SOURCE TESTING

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CHAPTER 5 - LARGE SOURCES AND PROCESS UNITS - SOURCE TESTING

This chapter contains the source testing frequency requirements for large sources. Also included are the source testing methods and procedures necessary for a Facility Permit holder of a large NOx source or process unit to establish an alternative emission factor. The Facility Permit holder of a large source or process unit may use a statistically equivalent methodology upon approval by the Executive Officer. Statistically equivalent methodologies shall be submitted to the Federal Environmental Protection Agency as an amendment to the State Implementation Plan (SIP).

Large sources and process units differ in the methodology used to evaluate source test data and determine the validity of the results.

Every large NO_X source shall be source tested no later than December 31, 1996 for Cycle 1 facilities and June 30, 1997 for Cycle 2 facilities, and every three years thereafter. In lieu of submitting the first source test report, the Facility Permit holder may submit the results of a source test not more than three years old which meets the requirements of this Chapter. The Facility Permit holder of a large source or NO_X process unit shall substantiate the emission rate according to the requirements set forth in this chapter.

A. Test Methods

The Facility Permit holders of major or large NO_X sources shall source test each equipment using the following test methods and procedures referenced in the District Source Test Manual and 40 CFR Part 60, Appendix A:

1. Determinations and measurements prior to sampling:

    a. Method 1.1 - sample points, stacks greater than 12 in. diameter

    b. Method 1.2 - sample points, stacks less than 12 in. diameter

    c. Method 2.1 - flow rate, stacks greater than 12 in. diameter

    d. Method 2.2 - flow rate, direct measurement

    e. Method 2.3 - flow rate, stacks less than 12 in. diameter

    f. Method 4.1 - moisture

    g. EPA Method 19 - calculated flow

    h. Direct in-stack instrumental flow measuring device

2. Nitrogen oxides concentration:

    a. Method 100.1 - nitrogen oxides

b. Method 7.1 - nitrogen oxides

3. Oxygen concentration:

a. Method 3.1 - molecular weight and excess air

b. Method 100.1 - oxygen

4 [Reserved for methodology to measure NO_X emissions from process units.]

B. Number of tests

To establish an alternative emission factor, a minimum of three separate tests shall be run at each condition or throughput that the equipment is expected to operate. Each set of tests should cover the different operating conditions of the cycle in sequence. The cycle would then have to be repeated in the same manner for the next set of tests. To comply with the source testing requirements on Table 5-B, one test at each condition or throughput level shall be run.

C. Testing frequency

The operator of all NO_X sources shall source test or tune-up their equipment according to the schedule in Table 5-B.

D. Sampling time and test procedures

1. For boilers, heaters, I.C. engines, turbines - tests should be conducted at low, mid and high load. The same sequence of operating conditions should be followed for each separate test, with each test condition being monitored for a minimum of 15 minutes.

2. Furnaces, kilns, dryers, calciners and ovens, operating continuously, have to be monitored for a minimum of 30 minutes, for each testing condition. For non-continuous operations (i.e., batch) samples must be taken for each phase of the operation (i.e. metal furnace charging, fluxing, melting, sweating and taping), for a minimum of 15 minutes or as long as the phase lasts. Data should be submitted on the time that it takes to complete each phase, and the emissions for the total cycle should be calculated based on the time required to complete each phase and the emissions measured during the corresponding phase.

3. Incinerators and afterburners are to be monitored for a minimum of 15 minutes at each operating temperature and at each flow rate.

4. Engine test cells are to be monitored over the total cycle if it lasts less than 30 minutes. Otherwise, monitor for 15 minutes at each engine test condition, or the total time if less than 15 minutes.

5. For the equipment not included above, an individual test plan must be submitted for approval by the Executive Officer. This plan must include justification on how the measurements will quantify equipment emissions.

E. Guidelines for Testing to Establish Emission Rate for Large Sources

1. For large sources the Facility Permit holder may elect to comply with an equipment-specific concentration limit, equipment-specific emission factor* or establish an average emission rate that accurately represents the emissions from the source over the range of operation under which the testing was done. The average emission rate shall be used to determine compliance with the facility's annual emission cap.

* on and after January 1, 1995 (Cycle 1 facilities) and July 1, 1995 (Cycle 2 facilities), large sources shall not be based on emission factors.

2. The criterion for acceptability of the emission rate shall be a 95% confidence interval that the tested emission rates will be within 20% of the average emission rate. If a single average emission rate does not meet this criterion over the entire range of operation, the District will allow up to three emission rates to cover a "normal operating range", a "high operating rate and a "low operating range," respectively. The "normal operating range" shall cover operations for at least 80% of the entire operating time. The average emission rate at the entire range or at respective low, normal, and high operating range shall be determined according to:

$$Er_C = (1/n) \sum_{i=1}^{n} ER_i \qquad \text{(Eq.32)}$$

$$S_{ER} = \left[\sum_{i=1}^{n} (ER_i - ER_C)^2/(n - 1) \right]^{1/2} \qquad \text{(Eq.33)}$$

$$CC = t_{0.975}\, S_{ER}/(n-1)^{1/2} \qquad \text{(Eq.34)}$$

$$\text{C.I. (\%)} = \frac{|CC|}{ER_C} \qquad \text{(Eq.35)}$$

where:

S_{ER} = The standard deviation (lb/mmBtu)

i = Each testing.

n = The number of testing data points to determine the average emission rate at entire range or low, normal, and high operating range, respectively

ER = The emission rate (lb/mmBtu) determined at each testing under each condition at the entire range or low, normal, and high operating range, respectively.

CC = The confidence coefficient

$t_{0.975}$ = The t value (one-tailed) determined from Table 5-A

ER_C = The average emission rate (lb/mmBtu) determined over an entire range, or determined at low, normal, and high operating range, respectively.

C.I. = The confidence interval with 95 % confidence level (%)

Table 5-A - Table of the Factor $t_{0.975}$ for Obtaining One-Tailed Confidence Interval for the Mean*

n*	$t_{0.975}$	n*	$t_{0.975}$	n*	$t_{0.975}$
6	2.571	9	2.306	12	2.201
7	2.447	10	2.262	13	2.179
8	2.365	11	2.228	14	2.160

* The values in this table are already corrected for n-1 degrees of freedom. Use n equal to the number of individual values. 40 CFR Part 60, App B, Spec. 1.

3. The Facility Permit holder shall identify the monitoring parameter(s) to establish the allowable operating range of process variables to be specified in the Facility Permit for the affected sources from Table 3-A in Chapter 3 for large sources. This list is not intended to be all inclusive and the Facility Permit holder may identify additional parameters not listed in Table 3-A. The test conditions are typically related to percent of load; however, the Facility Permit holder may propose any other monitoring parameters as deemed necessary and propose

the operating range of these monitoring parameters to ensure that the average emission rate(s) and control efficiency continue to fall within the confidence criterion.

4. The Facility Permit holder shall conduct source tests to verify the amended average emission rate according to the methods identified in Chapter 5, Subdivision A, or statistically equivalent methodologies. The testing shall be done in three phases.

5. Phase I testing shall constitute "normal operating range" testing. From the "normal operating range" the average emission rate shall be calculated by using the tested emission rates. To determine a tested emission rate the Facility Permit holder shall test at four conditions that span the "normal operating range". At each condition an emission rate shall be tested three times, but not consecutively. If there are two (or more) monitoring parameters the Facility Permit holder shall identify the primary parameter (i.e. having the greatest effect on emission rate variation) and secondary monitoring parameter(s), (i.e. having the least effect on emission rate variation). The Facility Permit holder shall test at four conditions that span the "normal operating range" of the primary monitoring parameter and at each primary monitoring parameter condition, test at least two secondary monitoring parameter test conditions that span the "normal range" of the secondary operating monitoring parameter(s). Each test shall be conducted for a period of at least 30 minutes. On this basis, the average emission rate and the 95% confidence interval shall be calculated. If the 95% confidence interval meets the 20% criterion, the unit shall be allowed to use this rate for "normal operating range" upon the approval of the Executive Officer. If the criterion is not met the Facility Permit holder shall reduce the "normal operating range" and conduct any additional tests to provide the required data sets.

6. Phase II testing shall constitute "high operating range" testing. The Facility Permit holder shall test at two conditions that span the "high operating range". At each condition an emission rate shall be tested three times, but not consecutively. Multiple operating conditions shall be addressed in a similar manner as described for Phase I testing. The values from these tests shall be added to the data from "normal operating range" testing and a test average emission rate and test 95% confidence interval shall be generated. If the 95% confidence interval for the test average emission rate meets the 20% criterion, then the test average emission rate shall become the allowed rate for both the "normal and high" operating ranges. If the criterion is not met, then a "high operating range" average emission rate and 95% confidence interval shall be calculated from the data. If the 20% criterion is met then the facility shall use this as a "high operating range" average emission factor. If the 20% criterion is

not met then tests at two additional conditions within the high range shall be conducted and the 20% criterion again applied to the "high operating range" data set only. If the 20% criterion is still not met, then the "high operating range" shall be reduced.

7. Phase III testing shall constitute "low operating range" testing. This Phase testing is carried out in the same manner as Phase II testing. If a single "normal/high operating range" emission rate has been determined from Phase II testing, then all of the data for "normal and high" operating range testing shall be included. If not, then only data from the "normal operating range" testing shall be included to create the "test average emission rate". The same acceptance criteria apply as specified under Phase II testing.

8. If the emission rate in each phase complies with the Confidence Interval, the Facility Permit holder may use up to three average emission rates, each representing a different phase, provided that load duration for each specified phase emission rate is monitored and recorded at the facility.

Example calculation:

In order to establish the average emission rate,the Facility Permit holder selected four operating conditions over the entire operating range. The results are as follows:

	Data 1	Data 2	Data 3
Condition 1	0.15	0.20	0.50
Condition 2	0.30	0.24	1.00
Condition 3	0.40	0.20	0.50
Condition 4	0.50	0.40	0.30

The confidence interval calculations are as follows:

ER_C = (0.15 + 0.20 + 0.50 + 0.30 + 0.24 + 1.00 + 0.40 + 0.20 + 0.50 + 0.50 + 0.40 + 0.30)/12 = 0.39083

S_{ER} = 0.219196 (according to Eq.32)

CC = (2.201) * 0.219196/$(11)^{1/2}$ = 0.1454

C.I.(%) = 0.1454/0.39083 = 37.2 % > 20 %

The proposed data set failed the confidence interval test, therefore the Facility Permit holder shall select low, normal, or high range, whichever is representative of their typical operating range according to Paragraphs 6.A.5.c.d.e.f. or g.

F. Guidelines for Testing to Establish Emission Rate for process units

1. For process units the Facility Permit holder shall comply with an average emission rate that accurately represents the emissions from the source or the unit over the range of operation under which the testing was done. The average emission rate shall be used to determine compliance with the facility's annual emission cap.

2. The average emission rate shall be calculated by using tested emission rates from a "normal operating range". The "normal operating range" shall cover operations for at least 80% of the entire operating time. The criterion for acceptability of these tested emission rates shall be an 95% confidence interval that the tested emission rates will be within 25% of the average emission rate. The average emission rate over the "normal operating range shall be determined according to:

$$ER_C = (1/n) \sum_{i=1}^{n} Er_i \qquad \text{(Eq.36)}$$

$$S_{ER} = [\sum_{I=1}^{n} (Er_i - ER_C)^2/(n - 1)]^{1/2} \qquad \text{(Eq.37)}$$

$$CC = t_{0.975} S_{ER}/(n - 1)^{1/2} \qquad \text{(Eq.38)}$$

$$\text{C.I. (\%)} = \frac{|CC|}{ER_C} \qquad \text{(Eq.39)}$$

where:

S_{ER} = The standard deviation (lb/mmBtu).

i = Each testing.

n = The number of testing data points to determine the average emission rate at the "normal operating range".

ER = The emission rate (lb/mmBtu) determined at each testing under each condition at the "normal operating range".

CC = The confidence coefficient.

$t_{0.975}$ = The t value (one-tailed) determined from Table 5-A.

ER_C = The average emission rate (lb/mmBtu) determined over the entire "normal operating range".

C.I. = The confidence interval with 95 % confidence level (%).

3. The Facility Permit holder shall identify the source test parameter(s) to establish the boundaries of operating conditions for the affected sources from Table 4-A in Chapter 4 for process units. This list is not intended to be all inclusive and the Facility Permit holder may identify additional source test parameters not listed in Table 4-A. The test conditions are typically related to percent of load; however, the Facility Permit holder may propose any other source test parameters as deemed necessary and propose the operating range of these source test parameters to ensure that the average emission rate(s) continue to fall within the confidence criterion.

4. The Facility Permit holder shall conduct source tests to verify the amended average emission rate according to the methods identified in Chapter 5, Subdivision A, or statistically equivalent methodologies. The testing shall be done over the "normal operating range".

5. From the "normal operating range" the average emission rate shall be calculated by using the tested emission rates. To determine a tested emission rate, the Facility Permit holder shall test at four conditions that span the "normal operating range". At each condition an emission rate shall be tested three times, but not consecutively. If there are two (or more) source test parameters the Facility Permit holder shall identify the primary source test parameter (i.e. having the greatest effect on emission rate variation) and secondary source test parameter(s), (i.e. having the least effect on emission rate variation). The Facility Permit holder shall test at four conditions that span the "normal operating range" of the primary source test parameter and at each primary source test parameter condition, test at least two secondary source test parameter test conditions that span the "normal range" of the secondary operating source test parameter(s). Each test shall be conducted for a period of at least 30 minutes. On this basis, the average emission rate and the 95% confidence interval shall be calculated. If the 95% confidence interval meets the 25% criterion, the unit shall be allowed to use this rate for "normal operating range" upon the approval of the Executive Officer. If the criterion is not met the Facility Permit holder shall reduce the "normal operating range" and conduct any additional tests to provide the required data sets.

G. Equipment tune-up procedures

Follow the "Equipment Tuning Procedure" as specified in Attachment D.

TABLE 5-B

SOURCE TESTING AND TUNE-UP FREQUENCY (1)

EQUIPMENT	TEST PER Q.A. PROGRAM	TEST EVERY THREE YEARS	TUNE-UP ONCE A YEAR	TUNE-UP TWICE A YEAR
BOILERS AND HEATERS				
Process Units				X
Large Sources		X		X
Major Sources	X			
I.C.E.				
Process Units			X[2]	X
Large Sources		X		X[2]
Major Sources	X			
KILNS/CALCINERS				
<10 TONS/HR		X		
>10 TONS/HR	X			
TAIL GAS UNITS	X			
FCCU	X			
PORTABLE EQUIPMENT			X	
ALL OTHER EQUIPMENT[3]			X	

1 Does not include Rule 219 Exempt Equipment

2 To Manufacturer's Specification

3 Does not include Equipment where combustion gases produce reducing and oxidizing conditions as part of the process (for example, metal melting furnaces which provide various alloys